Prior and new onset anemia in ST-elevation myocardial infarction: a different prognostic role?

Intern Emerg Med (2011) 6:329–336
DOI 10.1007/s11739-010-0494-2

EM - ORIGINAL

Prior and new onset anemia in ST-elevation myocardial infarction: a different prognostic role?

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Received: 29 July 2010 / Accepted: 17 November 2010 / Published online: 8 December 2010

Abstract The present investigation, performed in 1,122 consecutive STEMI patients treated with primary coronary intervention, was aimed at evaluating: (1) the prevalence of prior anemia and its prognostic significance in the short term; and (2) the prevalence of new anemia and its impact in the short term. The prevalence of prior anemia was 27.4%. Patients with a prior anemia were older and exhibited a higher incidence of chronic diseases and comorbidities. They showed a higher intra-hospital mortality rate ($p < 0.001$), a higher incidence of PCI failure ($p < 0.001$) and major bleedings ($p < 0.001$). Prior anemia was an independent predictor for intra-hospital mortality (OR 2.12; 95% CI 1.21–3.70, $p = 0.009$). Patients with a new anemia account for 46.8% of our series, and showed a higher early mortality rate and incidence of major bleedings in respect to those who maintained normal Hb values ($p < 0.05$ and <0.05, respectively). our data strengthens the prognostic role of Hb values in STEMI patients submitted to primary PCI, since the presence of prior anemia identified a subset of patients, characterized by advanced age, higher comorbidities and serious coronary artery disease, at higher risk for intra ICCU mortality and complications. Moreover, the development of anemia during an ICCU stay is common, and is associated with a higher mortality rate and incidence of complications in respect to patients who maintain normal Hb values.

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Keywords ST-elevation myocardial infarction · Percutaneous coronary intervention · Prior anemia · New anemia

Introduction

Recent guidelines on non-ST-elevation myocardial infarction (NSTEMI) [1] report that anemia is associated with a worse prognosis in patients with acute coronary syndromes (ACS). In these patients, a low admission hemoglobin (Hb) is an independent marker of the risk of ischemic and bleeding events at 30 days, and it should be taken into consideration in assessing the initial risk.

Existing data on the impact of anemia in patients with ST-elevation myocardial infarction (STEMI) treated with primary percutaneous coronary intervention (PCI) are inconsistent and lead to controversy [2–6].

The present investigation, performed in 1,122 consecutive STEMI patients treated with primary PCI, was aimed at evaluating: (1) the prevalence of a pre-existing anemia (prior anemia), and its prognostic significance in the short term; and (2) the prevalence of anemia developing during an intensive cardiac care unit (ICCU) stay (new anemia), and its impact on early mortality.

Methods

The clinical, angiographic, and in-hospital outcomes of 1,122 consecutive patients with STEMI (within 12 h from symptoms' onset), who were admitted to our ICCU from 1 January 2004 to 31 December 2009, were prospectively stored in a dedicated database. In our hospital, in Florence, the reperfusion strategy of STEMI patients is represented

by primary PCI [7]. STEMI patients are first evaluated by the medical emergency system staff in the pre hospital setting, and then directly admitted to the catheterization laboratory or transferred to it after a rapid stabilization in the emergency department (ED) After primary PCI, they are admitted to our ICCU.

The diagnosis of STEMI was based on the criteria of the American College of Cardiology/American Heart Association [8].

Coronary angiography and angioplasty were performed using standard techniques, by percutaneous femoral or radial artery approach. Before PCI, a 70 UI/kg i.v. bolus of unfractionated heparin was administered (bolus max 5000 UI), followed by additional weight-adjusted doses, in order to maintain an activated clotting time $\geq$250 s throughout the procedure. All patients were given 500 mg of aspirin and 300 or 600 mg clopidogrel. Abciximab was administered according to the operator's judgment.

A successful PCI was defined as an infarct artery stenosis <20% associated with thrombolysis in myocardial infarction (TIMI) grade 3 flow. Failure PCI was defined as resulting in TIMI grade 0 to 2 flow, regardless of the residual stenosis [9].

Anemia was defined in accordance with the World Health Organization (WHO) definitions (hemoglobin <13 g/dl in men and <12 g/dl in women) [10]. "New anemia" was defined as anemia (according WHO definition) developing during an ICCU stay.

Comorbidities were defined as follows [4]: prior stroke or transient ischemic cerebral attack, history of peripheral vascular disease, history of gastrointestinal bleeding, and history of genitourinary bleeding.

Major bleeding was defined according to the ACUITY criteria [11]: intracranial or intraocular bleeding; access site hemorrhage requiring intervention; 5 cm or more diameter hematoma; clinically overt blood loss with hemoglobin decrease $\geq$3 g/dl; any hemoglobin decrease $\geq$4 g/dl or blood product transfusion.

On ICCU admission, blood samples were obtained for hemochrome, cardiac biomarkers, glucose and serum creatinine levels, high-sensitivity C-reactive protein (hs-CRP), erythrocyte sedimentation rate (ESR), leukocyte and platelet counts. As indicated in our ICCU protocol, cardiac biomarkers, glucose, serum creatinine levels and hemochrome were evaluated every 6 h for the first 12 h, and every 8 h afterwards.

Estimated glomerular filtration rate (eGFR) was calculated according to the Levey modified MDRD formula [12].

For the present analysis, the following hemoglobin values were used: (1) Hb on ICCU admission; (2) nadir Hb (the lowest hemoglobin value during ICCU stay); (3) delta Hb (the difference between admission and nadir hemoglobin, g/dl) and (4) the percentage of variation in respect to Hb on admission (% delta Hb).

The study protocol was in accordance with the Declaration of Helsinki and approved by the local ethics committee.

Statistical analysis

The statistical analysis was performed using the SPSS software package (version 11.5, SPSS Inc., Chicago, IL, USA). Categorical variables are reported as frequencies and percentages; continuous variables as median and 25th–75th percentile. A statistical significance level (p) <0.05 was used. All hypothesis testings were two-tailed. Descriptive analyses were conducted on the entire data set, consistent of baseline demographic, clinical, laboratory and angiographic variables, by means of Pearson χ^2 test (or Fisher's exact test, when needed) and Mann–Whitney U test, as appropriate. We built a logistic regression model using methods suggested by Hosmer and Lemeshow [13].Variables thought to have clinical importance, and those with $p < 0.05$ in the univariable analysis, were included in the logistic model (Outcome: in-ICCU mortality; development of new anemia). The following baseline clinical characteristics were considered in the model: age, weight, smoking habits, comorbidities, renal failure, prior infarction, prior PCI, Killip class on admission, admission systolic blood pressure, admission Hb, nadir Hb, % delta Hb, CPK, Tn I, peak glycemia, admission and peak creatinine, ESR, coronary artery disease, PCI failure.

Results

Table 1 shows the baseline characteristics of all patients included in the study, and the comparison of three subgroups: (1) those who showed anemia on ICCU admission ("prior anemia"); (2) those who developed anemia during the ICCU stay ("new anemia"); (3) those who maintained normal Hb values during the ICCU stay ("normal Hb"). In our series, 307 patients (27.4%) were anemic on admission (prior anemia), while 525 patients (46.8%) developed anemia during the ICCU stay (new anemia). Two hundred and ninety patients maintained normal Hb values (25.8%) (Fig. 1). Prior anemia was more frequent in females in respect to patients with normal Hb ($p < 0.001$). Patients with prior anemia were older ($p < 0.001$) and with a lower BMI ($p < 0.001$), more frequently never smokers (that is patients who never smoked, $p < 0.001$), with comorbidities ($p = 0.043$), renal failure ($p < 0.001$), prior MI ($p < 0.001$) and prior PCI ($p < 0.001$).

Figure 2 shows the percentages of patients with prior anemia, new onset anemia and normal Hb values according

Table 1 Baseline characteristics of patients included in the study

	All patients, $n = 1{,}122$	Prior anemia, $n = 307$ (27.4%)	New anemia, $n = 525$ (46.8%)	Normal Hb throughout ICCU stay, $n = 290$ (25.8%)	p value
Females/males	293/829 (26.1/73.9%)	101/206 (32.9/67.1%)†	142/383 (27.0/73.0%)	50/240 (17.2/82.8%)†	<0.001
Age (years)	67 (58–77)	75.0 (65.0–81.0)*,†	66.0 (57.0–75.0)*,§	61.5 (53.0–71.0)†,§	<0.001
Weight (kg)	75 (65–83)	70.0 (60.5–80.0)*,†	75.0 (65.0–84.0)*,§	78.0 (70.0–88.0)†,§	<0.001
BMI (kg/m^2)	26.0 (23.7–28.1)	24.8 (22.8–27.2)*,†	26.1 (24.1–28.2)*	26.1 (24.6–28.7)†	<0.001
Hypertension	599 (53.4%)	170 (55.9%)	295 (56.5%)	134 (46.2%)	0.012
Diabetes	287 (25.6%)	112 (36.8%)	120 (23.0%)	55 (19.0%)	0.214
Dyslipidemia	404 (36.0%)	89 (29.3%)*,†	202 (38.7%)*,§	113 (39.0%)§,†	0.013
Smoke	698 (62.2%)	160 (52.6%)*,†	337 (64.4%)*,§	201 (69.3%)§,†	<0.001
Renal failure	50 (4.5%)	31 (10.1%)†	16 (3.0%)§	3 (1.0%)§,†	<0.001
COPD	95 (8.5%)	33 (10.8%)	37 (7.0%)	25 (8.6%)	0.175
Comorbility	93 (8.3%)	35 (11.4%)	41 (7.8%)	17 (5.9%)	0.043
Previous AMI	160 (14.3%)	68 (22.2%)*,†	57 (10.9%)*	35 (12.1%)†	<0.001
Previous angina	283 (25.2%)	69 (22.5%)	145 (27.6%)	69 (23.8%)	0.215
Previous PCI	154 (13.7%)	63 (20.6%)*	53 (10.1%)*	38 (13.1%)	<0.001
Previous CABG	25 (2.2%)	12 (3.9%)	9 (1.7%)	4 (1.4%)	0.060
ICCU therapy					
ASA	1083 (96.5%)	292 (95.4%)	510 (97.5%)	281 (97.2%)	0.229
Clopidogrel	1088 (97.0%)	285 (93.1%)	517 (98.9%)	286 (99.0%)	<0.001
Ticlopidine	11 (0.1%)	8 (2.6%)	2 (0.4%)	1 (0.3%)	0.002 (F)
UFH	969 (86.4%)	269 (87.6%)	449 (85.6%)	251 (86.9%)	0.719
β-Blockers	932 (83.1%)	222 (72.7%)	456 (87.7%)	254 (87.9%)	<0.001
ACE-I	1006 (89.7%)	251 (82.5%)	480 (92.5%)	275 (95.2%)	<0.001
ARB	24 (2.1%)	9 (2.9%)	9 (1.6%)	6 (2.1%)	0.381(F)
Diuretics	820 (73.1%)	243 (79.6%)	386 (74.2%)	191 (66.1%)	<0.001
Nitrates	577 (51.4%)	150 (49.0%)	275 (52.8%)	152 (52.6%)	0.543
Inotropes	168 (15.0%)	84 (27.4%)	70 (13.5%)	14 (4.9%)	<0.001

ICCU intensive cardiac care unit, *BMI* body mass index, *COPD* chronic obstructive pulmonary disease, *AMI* acute myocardial infarction, *PCI* percutaneous coronary intervention, *CABG* coronary artery by-pass graft, *UFH* unfractioned heparin, *ACE*-I angiotensin converting enzyme inhibitors, *ARB* angiotensin receptor blockers, *F* Fisher's exact test

* $p < 0.05$ prior anemia versus new anemia

† $p < 0.05$ prior anemia versus normal Hb throughout ICU stay

§ $p < 0.05$ new anemia versus normal Hb throughout ICU stay

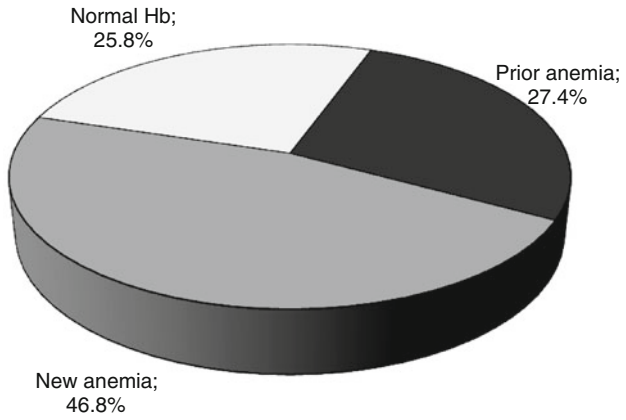

Fig. 1 Prevalence of prior anemia and new anemia in our population

to LVEF; no significant difference was observed among subgroups.

As depicted in Table 2, patients with prior anemia showed lower values of admission systolic blood pressure ($p = 0.004$) and left ventricular ejection fraction (<0.001) and a higher Killip class ($p < 0.001$).

Laboratory data are shown in Table 3. Patients with new anemia exhibited the highest values of peak Tn I ($p < 0.001$) and glycemia ($p < 0.001$), while prior anemia was associated with the lowest eGFR at admission ($p < 0.001$) and during the ICCU stay ($p < 0.001$). Patients with prior anemia showed highest values of ESR and the highest percentage of positive CRP.

Angiographic data are shown in Table 4. Patients with prior anemia showed a higher incidence of three-vessel

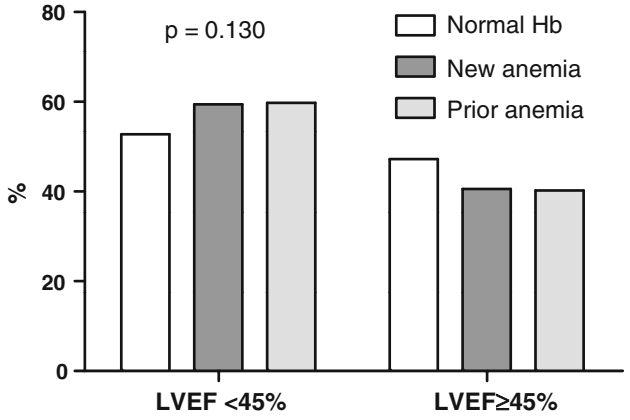

Fig. 2 Percentages of patients with prior anemia, new onset anemia and normal Hb values according to LVEF

coronary artery disease ($p < 0.001$) and PCI failure ($p < 0.001$) while stent implantation and abciximab use were less frequent in these patients ($p < 0.001$). Major bleeding and blood transfusions were more frequent in prior anemia ($p < 0.001$ and $p < 0.001$, respectively). Patients with prior anemia showed the highest intra-ICCU mortality (10.7%; $p < 0.001$) while patients who maintained normal Hb values showed the lowest mortality (1.7%). Patients with new anemia exhibited intermediate values of early mortality (2.9%).

Cardiogenic shock was the cause of death in the 90.6% (48/53), septic shock in 4/53 (7.5%) and ictus in one patient.

At logistic regression analysis the following variables were independent predictors for intra-ICCU mortality: age (OR 1.04; 95% CI 1.01–1.08; $p < 0.025$); prior anemia (OR 2.12; 95% CI 1.21–3.70, $p = 0.009$, even when corrected for weight), ejection fraction (OR 0.93; 95% CI 0.90–0.96 $p < 0.001$) and eGFR (OR 0.98; 95% CI 0.97–1.00 $p = 0.036$).

At logistic regression analysis the following variables were independent predictors for the development of new anemia during the ICCU stay (when adjusted for BMI, eGFR and abciximab use): age (OR 1.02; 95% CI 1.01–1.03; $p = 0.009$); peak Tn I (OR 1.01; 95% CI 1.00–1.03; $p = 0.042$); Killip class (OR 1.63; 95% CI 1.17–2.27; $p = 0.004$).

Discussion

In ACS, the prevalence of anemia, defined according to the WHO, shows a wide variation in literature data [14–20]. It is reported to have a prevalence of 5–10% in patients with NSTEMI ACS [21], of 43% in elderly STEMI patients [22] and of 12.8% in acute myocardial infarction (AMI) [4]. In

Table 2 Clinical presentation

	All patients, $n = 1{,}122$	Prior anemia, $n = 307$ (27.4%)	New anemia, $n = 525$ (46.8%)	Normal Hb throughout ICCU stay, $n = 290$ (25.8%)	p value
Admission heart rate (bpm)	77 (67–88)	77 (66–90)	78 (68–89)	76 (65–85)	0.169
Admission SBP (mmHg)	130 (115–145)	125 (110–145)*,†	130 (115–145)*	130 (119–147)†	0.004
ST decrease >50%	439 (62.4%)	106 (62.7%)	207 (61.6%)	126 (63.6%)	0.893
Killip class					
I	896 (79.9%)	214 (69.7%)†	414 (78.9%)	268 (92.4%)†	<0.001
II	100 (8.9%)	35 (11.4%)†	52 (9.9%)	13 (4.5%)†	
III	35 (3.1%)	13 (4.2%)†	18 (3.4%)	4 (1.4%)†	
IV	91 (8.1%)	45 (14.7%)†	41 (7.8%)	5 (1.7%)†	
AMI location					
Inferior	426 (38.0%)	132 (43.0%)	194 (37.0%)	100 (34.5%)	0.230
Lateral	91 (8.1%)	23 (7.5%)	46 (8.8%)	22 (7.6%)	
Anterior	605 (53.9%)	152 (49.5%)	285 (54.3%)	168 (57.9%)	
LVEF (%)					
Mean	43.2 ± 10.1	41.4 ± 11.0†	43.2 ± 9.9	44.9 ± 9.1†	<0.001
Median	45 (35–50)	45 (35–50)†	45 (35–50)§	45 (40–52)†,§	0.004

ICCU intensive cardiac care unit, *SBP* systolic arterial blood pressure, *AMI* acute myocardial infarction

* $p < 0.05$ prior anemia versus new anemia

† $p < 0.05$ prior anemia versus normal Hb throughout ICU stay

§ $p < 0.05$ new anemia versus normal Hb throughout ICU stay

Table 3 Laboratory data

	All patients, $n = 1,122$	Prior anemia, $n = 307$ (27.4%)	New anemia, $n = 525$ (46.8%)	Normal Hb throughout ICCU stay, $n = 290$ (25.8%)	p value
Admission Hb (g/dl)	13.7 (12.5–14.6)	11.4 (10.4–12.3)*,†	13.8 (13.3–14.5)*,§	14.9 (14.2–15.7)†,§	<0.001
Nadir Hb (g/dl)	11.8 (10.4–12.9)	10.0 (8.7–11.1)*,†	11.7 (10.8–12.4)*,§	13.5 (13.1–14.0)†,§	<0.001
Delta Hb (g/dl)	1.7 (1.0–2.6)	1.2 (0.4–1.9)*	2.3 (1.6–3.1)*,§	1.3 (0.7–2.0)§	<0.001
Delta Hb (% admission Hb)	12.7 (7.4–18.6)	10.1 (4.1–16.9)*,†	16.3 (11.6–22.4)*,§	8.8 (4.9–13.3)†,§	<0.001
Admission platelet count (×1,000/ml)	213 (175–256)	212 (166–276)	219 (182–256)§	206 (173–243)§	0.067
Peak TnI (ng/ml)	82.4 (37.0–177.5)	74.5 (32.3–181.5)*	99.0 (46.6–190.0)*,§	73.8 (31.5–150.5)§	<0.001
eGFR admission (ml/min/1.73 m^2)	78.2 (62.9–94.2)	72.4 (45.3–87.8)*,†	79.3 (65.2–95.3)*,§	84.2 (68.7–99.1)†,§	<0.001
nadir eGFR (ml/min/1.73 m^2)	70.9 (52.4–85.6)	58.2 (34.6–77.1)*,†	72.2 (57.1–87.2)*,§	75.7 (63.1–90.0)†,§	<0.001
Glycemia (mg/dl)	1.32 (1.12–1.72)	1.44 (1.20–2.06)*,†	1.33 (1.12–1.66)§,*	1.24 (1.05–1.53)§,†	<0.001
ESR (mm/h)	25 (13–42)	32 (17–58)*,†	25 (14–41)*,§	18 (9–29)†,§	<0.001
Positive hs-CRP	470 (50.5%)	146 (58.9%)†	227 (50.9%)	97 (41.1%)†	<0.001

ICCU intensive cardiac care unit, *LVEF* left ventricle ejection fraction, *eGFR* estimated glomerular fltration ratio, *ESR* erythrocyte sedimentation rate *hs-CRP* high sensibility C-reactive protein

* $p < 0.05$ prior anemia versus new anemia

† $p < 0.05$ prior anemia versus normal Hb throughout ICU stay

§ $p < 0.05$ new anemia versus normal Hb throughout ICU stay

our population, comprising unselected consecutive STEMI patients submitted to PCI, the prevalence of anemia was 27.4%, a value comparable with that reported by Archbold et al. [21] (22.4%) and by Valeur et al. [23] (25%).

The impact of anemia on mortality in AMI patients is still under debate [24, 25]. In a study [2] involving 39,922 ACS patients, anemia is a powerful and independent predictor of major cardiovascular events in a 30-day follow-up, especially in STEMI patients. Nikolsky et al. [4] report that, in patients with AMI submitted to coronary angioplasty, baseline anemia is strongly associated with adverse outcomes and increased mortality (30 days, 6 months and 1 year). On the other hand, Al Falluji et al. [3] document that anemia on admission has no significant direct effect on 1-year mortality, and that the higher unadjusted mortality observed among patients with AMI and anemia is probably the result of older age, higher comorbidity and more left ventricular dysfunction.

There are two main findings of the present investigation, performed in a large series of consecutive STEMI patients submitted to PCI.

Firstly, prior anemia, which is observed in about one-third of our population, represents an independent risk factor for intra-ICCU mortality, mainly because it is associated with advanced age, comorbidities (such as renal disease and previous heart disease) and complications (such as PCI failure and major bleedings). In our series, renal disease was more frequent in patients with a prior anemia, and renal dysfunction is known to be an adverse prognostic marker in patients with ischemic heart disease [26], in particular in those who are anemic [27]. In the acute phase, the presence of a prior anemia was also associated with a higher incidence of PCI failure, thus confirming previous investigations, reporting a higher occurrence of complications in anemic patients after PCI [27, 28]. In fact, in patients submitted to elective PCI, anemia has a role in nonfatal thrombotic coronary events and restenosis [28] and it is associated with higher short term adverse procedural events. In our series, though the use of abciximab was lower in patients with a prior anemia, the incidence of major bleedings was higher in these patients, in agreement with previous reports [4, 5, 19, 29].

Secondly, we documented that the development of a new anemia during the ICCU stay is quite common, involving about half of the patients; it is mainly related to phlebotomy, periprocedural bleeding, and groin hematoma. Advanced age and the extent of myocardial damage (as indicated by peak Tn I and a higher Killip class) were independent predictors for the development of a new anemia. We observed, for the first time that a new anemia is associated with a higher early mortality in respect to that observed in patients who maintain normal Hb values.

The long-term prognostic significance of changes in hemoglobin levels during hospital course was investigated by Aronson et al. [6] in 1,390 survivors of AMI. The authors report that anemia at discharge is a common finding (36%), and associated with an increased long term mortality.

In our series, the higher early mortality observed in patients with a new anemia in respect to those with normal Hb values can be related to several factors. Firstly, the incidence of major bleeding (as well as blood transfusions)

Table 4 Angiographic data and complications

	All patients, $n = 1{,}122$	Prior anemia, $n = 307$ (27.4%)	New anemia, $n = 525$ (46.8%)	Normal Hb throughout ICCU stay, $n = 290$ (25.8%)	p value
Coronary artery disease					
No disease	1 (0.1%)	1 (0.3%)	0 (0.0%)	0 (0.0%)	<0.001
1 to vessel	438 (39.0%)	105 (34.2%)†	197 (37.5%)	136 (46.9%)†	
2 to vessel	385 (34.3%)	96 (31.3%)	193 (36.8%)	96 (33.1%)	
3 to vessel	298 (26.6%)	105 (34.2%)†	135 (25.7%)	58 (20.0%)†	
Involvement of					
CABG	16 (1.4%)	7 (2.3%)	5 (1.0%)	4 (1.4%)	0.297
Left main	83 (7.4%)	27 (8.9%)	36 (6.9%)	20 (6.9%)	0.532
TIMI flow pre-PCI					
III	19 (1.7%)	6 (2.0%)	10 (1.9%)	3 (1.0%)	0.023
II	109 (9.7%)	25 (8.1%)	42 (8.0%)	42 (14.5%)	
I	194 (17.3%)	55 (17.9%)	80 (15.2%)	59 (20.3%)	
0	800 (71.3%)	221 (72.0%)	393 (74.9%)	186 (64.2%)	
IRA					
RCA	361 (32.2%)	111 (36.2%)	171 (32.6%)	79 (27.2%)	0.236
CX	145 (12.9%)	42 (13.7%)	61 (11.6%)	42 (14.5%)	
DA	593 (52.9%)	147 (47.9%)	281 (53.5%)	165 (56.9%)	
Left main	12 (1.1%)	3 (1.0%)	8 (1.5%)	1 (0.3%)	
CABG	10 (0.9%)	3 (1.0%)	4 (0.8%)	3 (1.0%)	
Stent implantation	996 (88.8%)	254 (83.0%)*,†	478 (91.0%)*,§	264 (91.3%)†,§	<0.001
Abciximab	546 (48.6%)	105 (34.2%)*,†	275 (52.4%)*,§	166 (57.2%)†,§	<0.001
TIMI flow post-PCI					
III	1056 (94.1%)	272 (88.5%)	499 (95.0%)	285 (97.6%)	<0.001
II	42 (3.7%)	18 (5.9%)*,†	21 (4.0%)*,§	3 (1.0%)†,§	
I	11 (1.0%)	6 (2.0%)	3 (0.5%)	2 (0.7%)	
0	13 (1.2%)	8 (2.6%)	3 (0.5%)	2 (0.7%)	
PCI failure	66 (5.9%)	32 (10.4%)†	27 (5.2%)	7 (2.4%)†	<0.001
Major bleeding	134 (11.9%)	53 (17.3%)†	78 (14.9%)§	3 (1.0%)†,§	<0.001
Blood transfusion	71 (6.3%)	52 (16.9%)*,†	18 (3.4%)*,§	1 (0.3%)†,§	<0.001
Dead patients	53 (4.7%)	33 (10.7%)*,†	15 (2.9%)*,§	5 (1.7%)†,§	<0.001

ICCU intensive cardiac care unit, *CABG* coronary artery by-pass graft, *PCI* percutaneous coronary intervention, *IRA* infarct related artery, *RCA* right coronary artery, *CX* circumflex coronary artery, *DA* descending anterior coronary artery

* $p < 0.05$ prior anemia versus new anemia

† $p < 0.05$ prior anemia versus normal Hb throughout ICU stay

§ $p < 0.05$ new anemia versus normal Hb throughout ICU stay

is higher in patients with a new anemia, though the use of abciximab was lower in respect to patients with normal Hb values. Secondly, the extent of myocardial injury is higher in patients with a new anemia. It is conceivable that the coexistance of a large infarct size and a newly developed anemia may predispose to tissue hypoperfusion, and thus to increased mortality.

The association between anemia and early mortality can be related to several factors: anemia may cause catecholamine excess, increase myocardial oxygen demand by necessitating a higher stroke volume and heart rate to maintain adequate systemic oxygen delivery, and lead to ischemia given restricted coronary flow. It may also promote the development of heart failure by causing adverse left ventricular remodeling.

In conclusion, our data strengthens the prognostic role of Hb values in STEMI patients submitted to primary PCI since the presence of a prior anemia identifies a subset of patients, characterized by advanced age, higher comorbidities and serious coronary artery disease, at higher risk for intra ICCU mortality and complications. Moreover, the development of anemia during the ICCU stay is common,

and is associated with a higher mortality rate and incidence of complications in respect to patients who maintain normal Hb values.

Conflict of interest None.

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